THE CONTEXTUAL FACTORS IN THE RECOGNITION OF COMMERCIALIZATION OPPORTUNITY AMONG MALAYSIAN PUBLIC UNIVERSITIES RESEARCHERS

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ABSTRACT

Malaysia is striving to achieve the status of a high income and developed nation as envisioned by Vision 2020, where innovation plays an ever-increasing and important role to sustain a rapid rate of economic growth, enhance international competitiveness. The Government has taken various initiatives to support technology commercialization in Malaysian Public Universities such as the allocation of huge funding for Research and Development (R&D) activities. However, besides the huge amount allocated for R&D, the commercialization rate is very low. If this situation is unchecked, then the Government vision for wealth creation would not be achieved. Therefore, the purpose of this study is to observe the capability of the researchers in the recognition of commercialization opportunity. This study also aims to determine the contextual factors that could influence a researcher's capability in the recognition of commercialization opportunity. Online questionnaires were sent to 400 respondents among Malaysian Public Universities' researchers in the field of Science and Technology. The questionnaires covered elements such as knowledge, researcher's behavior, social network and university support. Of 400 respondents, 101 complete responses were received and analyzed. This study identified that knowledge, researcher's behavior and social network are factors required to recognize the commercialization opportunity successfully. This study has indicated that the Malaysian Public universities' researchers possess greater technological knowledge, knowledge of the customer, knowledge of the government's rules and regulations and knowledge of the customer's problems. The researchers were found to be creative in R&D and proactively search information related to their R&D fields. Most of the researchers also believed that commercialization of their technology are their strongest motive in R&D activities. Results of this study also indicated that the researchers possess moderate capability in the knowledge of the competitor, knowledge of costing, informal interaction with industries, supplier, involvement of multidisciplinary research team and participation in professional forums. However, the researchers were found to have poor capability in formal interaction with industries and with mentors. Researcher's level of education, industrial work experience and university support were found to play as a moderator that strengthen the relationship between knowledge, researcher's behavior, social network and the recognition of commercialization opportunity.

ABSTRAK

Malaysia sedang berusaha untuk mencapai status negara berpendapatan tinggi dan maju seperti yang dihasratkan oleh Wawasan 2020, di mana inovasi memainkan peranan yang semakin penting untuk mengekalkan kadar pertumbuhan ekonomi yang pesat dan meningkatkan daya saing di peringkat antarabangsa. Kerajaan telah mengambil pelbagai inisiatif untuk menyokong pengkomersialan teknologi di Universiti-universiti awam di Malaysia seperti memberi peruntukan pembiayaan yang besar bagi Penyelidikan dan Pembangunan (R & D). Walau bagaimanapun, di samping jumlah besar yang diperuntukkan untuk R & D, kadar pengkomersialan adalah sangat rendah. Jika keadaan ini tidak diatasi, maka wawasan Kerajaan untuk menjana kekayaan tidak akan dapat dicapai. Oleh itu, tujuan kajian ini adalah untuk melihat keupayaan penyelidik dalam mengenali peluang pengkomersialan. Kajian ini juga bertujuan untuk mengkaji faktor-faktor konteks yang diperlukan untuk membina keupayaan penyelidik dalam mengenali peluang pengkomersialan. Soal selidik dalam talian telah dihantar kepada 400 responden di kalangan penyelidik-penyelidik di Universiti-universiti Awam di Malaysia dalam bidang Sains dan Teknologi. Soal selidik meliputi elemen-elemen seperti tingkah laku penyelidik, pengetahuan, rangkaian sosial dan sokongan universiti. Daripada 400 responden, 101 jawapan yang lengkap telah diterima dan dianalisa. Kajian ini mengenal pasti bahawa pengetahuan, tingkah laku penyelidik dan rangkaian sosial adalah faktor-faktor yang diperlukan untuk mengenali peluang pengkomersialan dengan jayanya. Kajian ini telah menunjukkan bahawa penyelidik universiti-universiti awam Malaysia mempunyai pengetahuan kukuh tentang teknologi berkaitan dengan bidang kajian mereka, pengetahuan tentang pelanggan, pengetahuan tentang undang-undang, peraturan-peraturan kerajaan dan pengetahuan tentang masalah pelanggan. Para penyelidik merupakan penyelidik yang kreatif dalam R & D dan proaktif di dalam mencari maklumat yang berkaitan dengan bidang R & D mereka. Kebanyakan penyelidik percaya bahawa pengkomersilan teknologi yang dihasilkan merupakan motif utama mereka di dalam aktiviti-aktiviti R & D. Keputusan kajian ini juga menunjukkan bahawa penyelidik mempunyai keupayaan yang sederhana dalam ilmu pengetahuan tentang pesaing, pengetahuan tentang pengiraan kos, interaksi secara tidak formal dengan industri, pembekal, penglibatan pasukan penyelidikan daripada pelbagai disiplin dan penyertaan dalam forum profesional. Bagaimanapun, penyelidik telah didapati mempunyai kelemahan di dalam interaksi formal dengan industri dan dengan mentor. Tahap pendidikan dan pengalaman kerja di industri yang dipunyai oleh penyelidik serta sokongan universiti merupakan *moderator* yang mengukuhkan hubungan antara tingkah laku penyelidik, pengetahuan, rangkaian sosial dan mengenali peluang pengkomersialan.

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f	frequency
%	percentage
α	alpha
β	beta

LIST OF ABBREAVIATIONS

CRDF	Commercialization R&D Fund
EPU	Economic Planning Unit
IGS	Industrial R&D Grant Scheme
IP	Intellectual Property
IRPA	Intensification of Research in Priority Areas
MARDI	Malaysian Agriculture Research Institute
MOHE	Ministry of Higher Education, Malaysia
PhD	Doctor of philosophy
R&D	Research and Development
SWOT	Strength, Weaknesses, Opportunity and Threat
UNCTAD	United Nations Conference on Trade and Development
USPTO	US Patent and Trademark Office

CHAPTER 1

PROBLEM BACKGROUND

1.1 INTRODUCTION

The main aim of this thesis is to investigate contextual factors that may enhance a researcher's capability in recognizing the commercialization opportunity. The thesis also investigates the researcher's present capability in the recognition of commercialization opportunity.

This section is divided into seven sub-sections. It begins with the explanation of problem background of the research, followed by the problem statement, objectives of the study, research questions and hypotheses development. The chapter is culminated by presenting the conceptual framework, operational definition and significance of the study.

1.2 PROBLEM BACKGROUND

Malaysia is striving to achieve the status of a high income and developed nation as envisioned by Vision 2020, where innovation plays an ever-increasing and important role to sustain a rapid rate of economic growth, enhance international competitiveness. Vision 2020 is a 30-year plan to "push" Malaysia to achieve a level at par with the industrial nations in terms of economic performance and technological capability (Mustapha and Abdullah, 2000). The human capital is a key to innovation where the capability to create, innovate, generate and exploit new ideas as well as to apply technology and exercise superior entrepreneurial skills are essential. The ways in which innovation takes place can be diverse, but an important source of innovation is through

R&D (UNCTAD, 2005). Research and Development (R&D) is one source of innovation and it has been recognized as a critical determinant of a country's competitiveness worldwide including Malaysia (Ismail et al., 2008a). R&D involves novelty and the resolution of scientific and technological uncertainty. It includes basic and applied research along with development. Basic research is defined as research that advances scientific knowledge but does not have specific immediate commercial objectives, while applied research includes investigations to discover new scientific knowledge that has specific commercial objectives with respect to products, processes, or services. Hence, development is the systematic use of the knowledge or understanding gained from research directed towards the production of useful materials, devices, systems or methods, including the design and development of prototypes and processes (UNCTAD, 2005).

Public research institutes and universities play a significant role in R&D and commercialization of R&D results to achieve financial sustainability and to ensure the success of the national mission. According to Speser (2008), there are primarily three main paths for commercialization of R&D results. The first path is strategic alliance. Here the technology owner signs an agreement with another party under which each party is bound to do a specific things. For example, one company may provide the product while the other may distributes and sells it. In a university setting, sponsored research contracts may incorporate a strategic alliance. Under some sponsored research, the sponsor has the right to patent any inventions of interest in the name of the university in exchange for a first right of refusal to license them. The second path is setting up a company to exploit the technology. "Spin-outs" make sense where there is a high value platform technology with good intellectual property protection and a very committed entrepreneur. They may also make sense if additional R&D funding is needed to mature the technology and there are sources of funds that only small businesses can tap. The third path is licensing. This path makes sense if the other ones do not or if one wants to hedge his bets and pursue two paths simultaneously. Joint ventures are a hybrid of spin-out and licensing. In joint ventures, two or more parties come together and establish a free-standing company. Owners of technology license their technology to the joint venture as part or all of their contribution to capital. They receive equity in the joint venture in return. Others may put in money, staff, equipment, or other resources.

Government involvement in R&D begins with Malaysia's Five Year Plans (1986-1990). In the sixth Malaysian Plan (1991–1995), the Government set goals for continuous scientific and technological development by providing basic infrastructure incentives and supporting services to science and technology. Public R&D programs were made more market-oriented to exploit the commercialization of research and technology. The private sector was expected to complement the government in expanding R&D in science and technology by using appropriate technology assimilation, diffusion and application. The seventh Malaysia Plan (1996–2000) focused on economic growth and competitiveness by increasing productivity, recognizing Malaysia's need to develop its technology infrastructure further and expand its capacities for technology adoption and assimilation. A program of Intensification of Research in Priority Areas (IRPA) was introduced which included approval of a total of 3,705 projects worth RM698.3 million to Malaysian research institutes including public universities (Malaysia, 1996). The purpose of the IRPA Program was to focus on R & D activities on high potential projects to boost economic performance. There are four principles of IRPA selection (EPU, 2001). First is to fund commercially viable developments which have high national priority. Second, projects are selected to help satisfy various gaps in the efforts of and needs of Malaysian industry. Third, projects should enhance collaborative efforts between researchers and the research institutions. Finally, they should enhance R&D links between relevant public sector and industries.

Malaysia has taken various initiatives to increase the rate of commercialization of R&D results. Business units at Public Research Institutions and universities have been reorganized and strengthened to help them better identify and implement market-oriented R&D projects through interaction among researchers and the private sector. To generate more R&D projects with commercial potential, Public Research Institutions and universities have been encouraged to undertake more research on product and process development for industry. To facilitate commercialization of R&D findings and technology, the Eighth Malaysia Plan (2001-2005) allocated RM 610 million (Malaysia, 2001). Fiscal incentives were provided to encourage venture capitalists to invest in start-ups involving indigenous technology.

In the Ninth Malaysia Plan (2006-1010), efforts were intensified to commercialize at 10 percent of the public-funded R&D projects. The government has set up the Science Fund and Techno Fund in an effort to increase the rate of commercialization. The Science Fund is a R&D grant scheme, which provides funding from basic research to the development of laboratory-scale prototypes. The Techno Fund is a grant scheme to develop technologies for commercialization. The scope of Techno Fund includes development of commercial-ready prototypes, pilot plant and incubation activities to address the funding gap of pre-commercialization activities. The amount of fund for R&D allocated to the research institutes has been increased in the 7th to 9th Malaysia Plan, as can be seen in Table 1.1.

Table 1.1: Government allocation of Fund on R&D to Public sectors

Malaysia Plan	Total R&D allocation	R&D allocation for IRPA	Science Fund/ Fundamental Research
		RM millions	
Fifth Malaysia Plan (1986-1990)	400	-	
Sixth Malaysia Plan (1991-1995)	600	-	
Seventh Malaysia Plan (1996-2000)	935	755	-
Eight Malaysia Plan (2001-2005)	1400	837	-
Ninth Malaysia Plan (2006-2010)	5253	-	1582

Adapted from Fifth Malaysia Plan (Malaysia, 1986), Sixth Malaysia Plan (Malaysia, 1991), Seventh Malaysia Plan (Malaysia, 1996), Eight Malaysia Plan (Malaysia, 2001) and Ninth Malaysia Plan (Malaysia, 2006).

1.2.1 Performance of Malaysia in R&D and commercialization

The performance of Malaysia in R&D and commercialization can be assessed on two indicators; the number of Intellectual Property (IP) granted and the number of R&D results that have been commercialized. As can be seen in Table 1.2, with regards to the number of publicly funded projects run by the Malaysian Public Universities from year 2005 – 2009, the number of IPs approved are apparently very low as compared to the funded project carried out by the researcher. The performance of Malaysia in international league is reflected by the number of patents recorded in US Patent and Trademark Office (USPTO). As Table 1.3 shows, Malaysia is left far behind South Korea and Taiwan. The performance of Malaysia is even lower than Singapore.

Table 1.2: Number of funded projects, IPs and commercialization of R&D projects in Malaysian Public Universities

Year	No. of funded projects	No. of IPs approved	No. of R&D projects commercialized				
			Licensing	Joint ventures	Royalty	Others	Total
2005	2601	34	8	1	6	1	16
2006	2900	32	4	1	1	2	8
2007	6737	83	-	1	12	3	16
2008	3594	714	10	3	2	10	25
2009	5275	384	9	7	14	-	30

Source: MOHE (2010)

Table 1.3: Comparison of the number of US patents among Malaysia and other Asian countries

Country	2007	2008	2009	2010
Malaysia	**173**	**168**	**181**	**224**
Singapore	451	450	493	633
Taiwan	7491	7779	7781	9635
South Korea	7264	8730	9566	12508
Thailand	17	16	11	18

Adapted from US Patent and Trademark Office (2010)

In addition to generating low number of patentable innovation compared to some Asian countries, Malaysia also lags behind in commercialization of R&D especially in public research institutes and universities. A survey of 5232 projects implemented by public research institutes and universities during sixth and seventh Malaysia Plan revealed that while 14.1 per cent of these projects were identified as potential candidates for commercialization, only 5.1 per cent were commercialized (Malaysia, 2001). An evaluation of R&D projects funded under the IRPA programme during the Seventh Malaysia Plan, revealed that only 3.4 percent of the projects were commercialized during the Eight Plan period (Malaysia, 2006). The poor performance of Malaysian Public Universities in commercialization also can be seen in Table 1.2.

1.3 PROBLEM STATEMENT

Every researcher, after carrying out R&D and especially applied research, is expected to commercialize their R&D results to contribute to the national economic competitiveness and innovation growth. However, despite of the huge amount of fund allocated for R&D, the patents produced and commercialization rate is very low (Govindaraju et al, 2009a). If this situation remains unchecked, the government's vision for wealth creation would not be achieved. Therefore, the purpose of this study is to

observe the capability of the researchers in the recognition of commercialization opportunity. This study also aims to examine the contextual factors required to build researchers' capability in the recognition of commercialization opportunity.

1.4 RESEARCH OBJECTIVES

This study has been undertaken with two main purposes. Firstly, this study is an effort to determine the contextual factors that could influence a researcher's capability in the recognition of commercialization opportunity. Secondly, this study also attempts to reveal the present capabilities of researchers in the recognition of commercialization opportunity. Therefore, four objectives have been developed to achieve the aforementioned purposes of this research:

a. To determine the researchers' perceived importance towards recognition of commercialization opportunity

b. To examine the researchers' perceived capability towards the recognition of commercialization opportunity

c. To analyze the relationship between the independent variables and the recognition of commercialization opportunity

d. To observe the influence of the moderator variables between the relationship of the independent variables and the recognition of commercialization opportunity

1.5 RESEARCH QUESTIONS AND HYPOTHESIS DEVELOPMENT

Four specific questions have been designed in order to achieve research objectives of the study.

Question 1: What is the perceived importance of the researchers in the independent variables towards the recognition of commercialization opportunity?

Question 2: What is the perceived capability of the researchers towards the recognition of commercialization opportunity?

Question 3: Is there a correlation between the researchers' independent variables towards the recognition of commercialization opportunity?

This question leads to the following hypotheses that have been divided into three categories in order to examine the correlation between the knowledge, the researcher's behavior and the social network for the successful commercialization opportunity recognition.

a. Correlation between knowledge and the recognition of commercialization opportunity

H1: Each knowledge component has a positive correlation with the recognition of commercialization opportunity

b. Correlation between researcher's behavior and the recognition of commercialization opportunity

H2: Each researcher's behavior component has a positive correlation with recognition of commercialization opportunity

c. Correlation between social network and the recognition of commercialization opportunity

H3: Each social network component has a positive correlation with recognition of commercialization opportunity

Question 4: Do moderating variables strengthen the relationship between the independent variables and the recognition of commercialization opportunity?

This question leads to the following nine hypotheses:

H4: The strength of the relationship between knowledge and the recognition of commercialization opportunity depends upon the education level, such that it is stronger for the researcher with a PhD degree as compared to Masters level of education

H5: The strength of the relationship between researcher's behavior and the recognition of commercialization opportunity depends upon the education level, such that it is stronger for the researcher with a PhD degree as compared to the Masters level of education

H6: The strength of the relationship between social network and the recognition of commercialization opportunity depends upon the education level, such that it is stronger for the researcher with a PhD degree as compared to Masters level of education

H7: The relationship between knowledge and the recognition of commercialization opportunity is strengthen with the presence of industrial work experience so that the relationship is stronger to the researcher with some industrial work experience than the one without any industrial work experience

H8: The relationship between the researcher's behavior and the recognition of commercialization opportunity strengthens with the presence of industrial work experience so that the relationship is stronger to the researcher with some industrial work experience than the one without any industrial work experience

H9: The relationship between social network and the recognition of commercialization opportunity strengthens with the presence of industrial work experience so that the relationship is stronger to a researcher with some industrial work experience than the one without any industrial work experience

H10: The strength of the relationship between knowledge and the recognition of commercialization opportunity depends upon university support, so that when the university support is strong, the relationship also gets stronger

H11: The strength of the relationship between researcher's behavior and the recognition of commercialization opportunity depends upon university support, so that when the university support is strong, the relationship also gets stronger

H12: The strength of the relationship between social network and the recognition of commercialization opportunity depends upon the university support, so that when the university support is strong, the relationship also becomes stronger

1.6 CONCEPTUAL FRAMEWORK

Opportunity recognition is an essential issue in entrepreneurship (Kirzner, 1979; Ventakaraman, 1997), one of the key aspect in commercialization process (Farsi and Talebi, 2009; Smith, 2002), and an essence in the development of the idea that the corporate entrepreneur seeks to manage and exploit (Shaw et al., 2005). Opportunity recognition is an entrepreneurial theory which discuss on how an entrepreneur recognize the opportunity that leads to business development. Prior research revealed that knowledge, social network and personal behavior have strong influence on the recognition of the opportunity process. Therefore, this study adopts an opportunity recognition theory and in an effort to examine the applicability of this theory to the researcher.

The conceptual framework of this study is shown in Figure 1.1. The conceptual framework depicts the relationship of knowledge, researcher's behavior and social network. Three items; the education level, the industrial work experience and the university support are used as moderator variables.

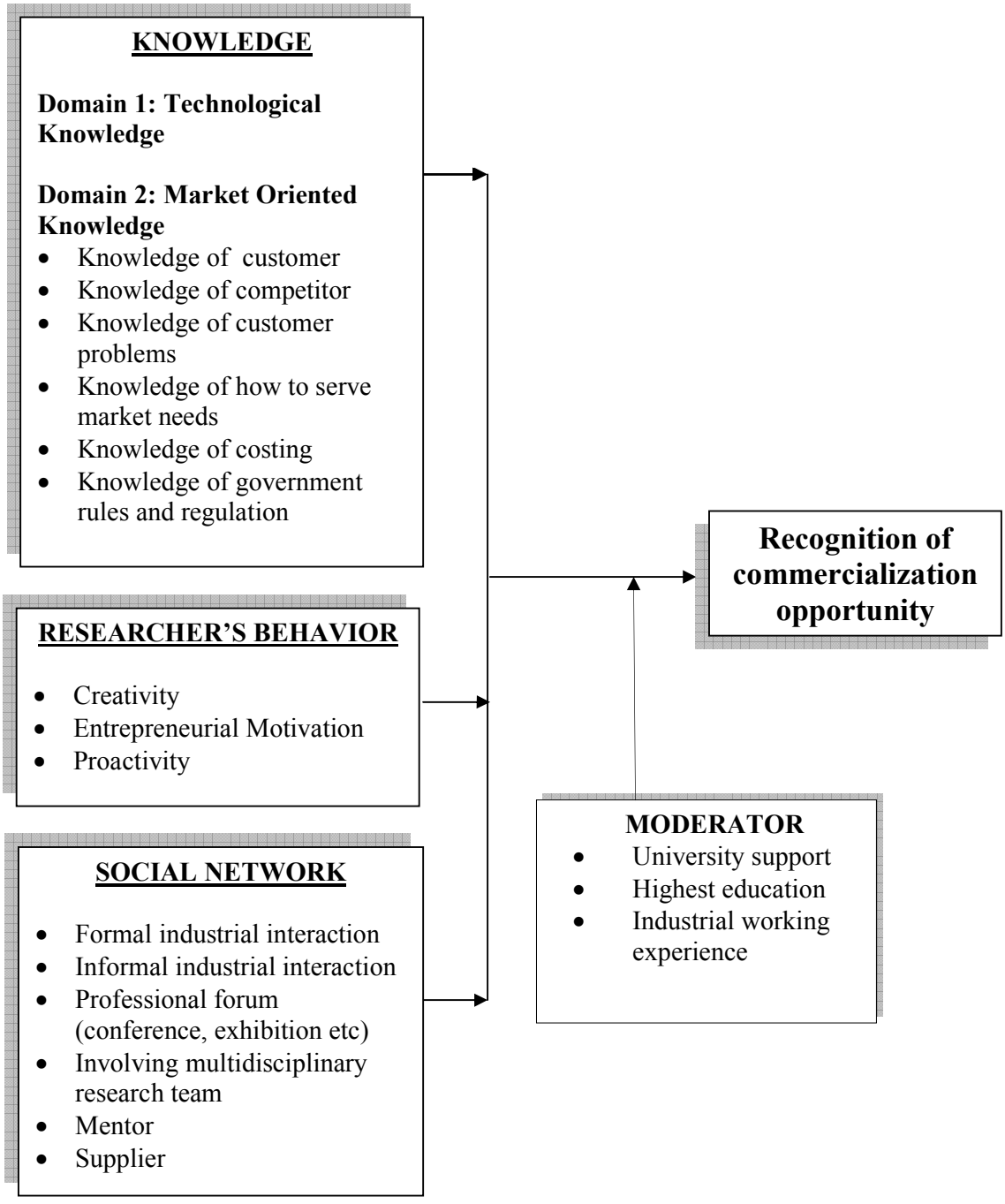

Figure 1.1: A schematic illustration of the conceptual framework. Adapted from the model of Ardichville et al., (2003)

1.7 OPERATIONAL DEFINITION

The key terms are defined below according to what they mean within this study.

a. Commercialization opportunity

While many definitions of the term opportunity have been proposed, most include references to the three central characteristics: potential economic value (i.e., the capacity to generate profit), newness (i.e., some product, service, or technology that did not exist previously), and perceived desirability (e.g., moral and legal acceptability of the new product or service in society). For the purpose of this study, the commercialization opportunity is defined as **"the innovative ideas that are potentially marketable".**

b. Contextual factors

Contextual factors are defined as **important factors that could influence the researcher to recognize the commercialization opportunity.** In this study, contextual factors used are knowledge, researcher's behavior and social network.

c. Researcher's capability

The term of 'researcher's capability' is defined as **the researcher's strength in the domain of this study: knowledge, behavior and social network.**

d. Malaysian Public Universities

Universities that are funded by the Government and are governed as self-managed institutions. Until recently, there are 20 public universities in Malaysia.

e. Proactivity

The term of 'proactivity' is defined as **actively search information related to researcher's R&D fields.**

f. Creativity

Creativity is defined as **the ability to produce something new through researcher's imagination.**

g. Mentor

In this study, the term of 'mentor' refers to **university colleague that has commercialized his/her R&D result.**

h. Researcher

Researcher refers to **an individual who carry out R&D activities.**

i. Science and Technology

Science and technology is a term of art used to encompass the relationship between science and technology. Science is **discovering new things**. Technology is **taking the science and making it into practical, useful, saleable products**.

j. Entrepreneurial opportunity

In this study, the terms of 'entrepreneurial opportunity' and 'commercialization opportunity' **were used interchangeably**.

1.8 SIGNIFICANCE OF THE STUDY

In the Ninth and Tenth Malaysia Plan, the government of Malaysia has given higher priority to market oriented R&D, increasing the rate of commercialization as well as enhancing human capital to strengthen technological capability and capacity to support innovation-led growth. Therefore, this study is an attempt to facilitate the Malaysian researchers, policy makers and the university leaders. Besides, this study is will hopefully contribute to the theory of recognition opportunity and technology commercialization.

a. Researchers

Through this study, the important factors that are significant to enhance the researcher's capability in commercialization opportunity will be identified. These factors can be used as guidance by the researchers to improve their quality of research and enhance their absorptive capacity.

b. Policy makers

Observing the capability of the researchers in the recognition of commercial value research is also significant for this study. The policy maker needs to be informed about the strengths and weaknesses of the researchers and the factors to enhance a researcher's capability. The outcome of this study can be helpful in altering the related policy.

c. University leaders

The result of this study can also be helpful to the university leaders. The university can develop strategies; in terms of capacity and capability building of their researchers in R&D and in turn can enhance the rate of commercialization of R&D.